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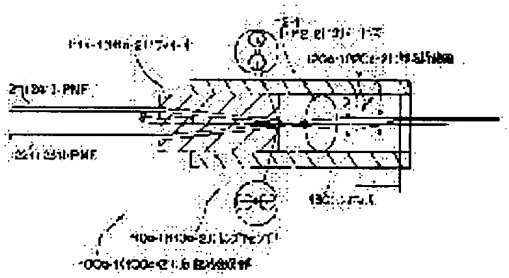
(54) POLARIZED LIGHT SYNTHESIZER, POLARIZED LIGHT SEPARATING DEVICE AND EXCITED LIGHT OUTPUT DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To remarkably reduce mounting dimensions while keeping the conventional function as an optical circuit device, the required light resistance, reliability and manufacturing easiness in a polarized light synthesizer.

SOLUTION: This polarized light synthesizer includes a lens assembly 110a-1 having a fixing member 111a-1 for fixedly disposing the ends of plural optical fibers 211, 221 capable of propagating different polarized component light and a lens 112-1 for converting polarized component light of plural kinds emitted from the respective optical fibers 211, 221 to a collimate beam, wherein the synthesizer further includes a double refraction member 120a-1 for polarizing and synthesizing polarized component light of plural kinds as the same optical axis by using a difference in refractive index characteristic between polarized component light of plural kinds emitted from the lens 112-1.



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CLAIMS

[Claim(s)]

[Claim 1] The fixing member which carries out fixing arrangement of the edge of two or more optical fibers which can spread a mutually different polarization component light, While offering the lens assembly which comes to offer the lens changed into a collimation beam from each optical fiber about two or more kinds of polarization component light by which outgoing radiation was carried out The polarization synthesizer unit characterized by having offered the birefringence member which carries out polarization composition, and being constituted by using two or more above-mentioned kinds of polarization component light as the same optical axis by using the difference in the refractive-index property between two or more above-mentioned kinds of polarization component light by which outgoing radiation was carried out from this lens.

[Claim 2] The polarization synthesizer unit according to claim 1 characterized by having arranged proximity or the monotonous birefringence crystal toward which the crystallographic axis inclined acutely to the travelling direction of light as this birefringence member while being constituted that it is made to incline and fixing arrangement should be carried out so that it might touch for the edge of each other in the two above-mentioned optical fibers which can carry out outgoing radiation of the two different light in which this fixing member has the plane of polarization which intersected perpendicularly mutually.

[Claim 3] The polarization synthesizer unit according to claim 2 characterized by being constituted when this fixing member joins two ferrule members which fix each of two above-mentioned optical fibers.

[Claim 4] The polarization synthesizer unit according to claim 1 characterized by having arranged the birefringence crystal of the shape of a taper the shape and a crystallographic axis cross at right angles to an optical axis as this birefringence member while being constituted that fixing arrangement of the two above-mentioned optical fibers which can carry out outgoing radiation of the two different light in which this fixing member has the plane of polarization which intersected perpendicularly mutually should be carried out in parallel.

[Claim 5] The polarization synthesizer unit according to claim 1 characterized by what was constituted by the plane-of-polarization maintenance optical fiber which holds a polarization state and can spread two or more different light with the plane of polarization plane of polarization and the optical fiber of these two or more books crossed at right angles mutually, respectively.

[Claim 6] the above in the birefringence crystal of the shape of this taper -- double -- the reflected light on the street by this coupler film while the vacuum evaporationo of the coupler film is carried out to plane of incidence with a large incident angle among two or more plane of incidence in which some kinds of polarization component light carries out incidence -- the above -- double -- the polarization synthesizer unit according to claim 1 characterized by having offered the monitor section which carries out a monitor and being constituted about some kinds of polarization component light

[Claim 7] The polarization synthesizer unit according to claim 6 characterized by for this monitor section having offered the photodiode which carries out a monitor, and constituting it about the sum component of two or more above-mentioned kinds of polarization component light.

[Claim 8] The polarization synthesizer unit according to claim 6 characterized by for this monitor section having offered two or more photodiodes which carry out a monitor individually, and constituting it about two or more above-mentioned kinds of each polarization component light.

[Claim 9] About two or more kinds of mutually different polarization components contained in the light by which outgoing radiation was carried out from one optical fiber While offering the birefringence member which may be divided into the polarization component light of a kind by using the difference in the refractive-index property between two or more above-mentioned kinds of polarization component light The lens changed into a collimation beam from this birefringence member about the polarization component light by which outgoing radiation was carried out, The polarization decollator characterized by having offered the lens assembly which comes to offer the fixing member which carries out fixing arrangement of the edge of the optical fiber which can spread each of two or more above-

mentioned kinds of polarization component light collimated with this lens, and being constituted.
[Claim 10] The polarization composition section compounded about polarization component light which is mutually different while it has the same wavelength range is offered. The fixing member which carries out fixing arrangement of the edge of two or more optical fibers which can spread the polarization component light from which it is excitation optical output equipment which may output the light compounded in this polarization composition section as an excitation light for optical amplification, and this polarization composition section differs mutually, The lens assembly which comes to offer the lens changed into a collimation beam from each optical fiber about two or more kinds of polarization component light by which outgoing radiation was carried out, By using the difference in the refractive-index property between two or more above-mentioned kinds of polarization component light by which outgoing radiation was carried out from this lens Excitation optical output equipment which carries out polarization composition and is characterized by having offered the birefringence member which can carry out outgoing radiation in parallel with one different output optical fiber from two or more above-mentioned optical fibers, and being constituted by using two or more above-mentioned kinds of polarization component light as the same optical axis.
[Claim 11] Excitation optical output equipment according to claim 10 characterized by being constituted so that the light compounded in this polarization composition section may be used as the object for front excitation to the remote light amplifier connected through the above-mentioned output optical fiber, or an excitation light for back excitation.
[Claim 12] Excitation optical output equipment according to claim 10 characterized by having offered the wavelength demultiplexing section which performs wavelength multiplex or wavelength separation processing, and being constituted between the light compounded in this polarization composition section, and the signal light which included data information while it had different wavelength from the above-mentioned light compounded in this polarization composition section.
[Claim 13] The 1st polarization composition section which can be compounded about the 1st excitation light which has a polarization component which is mutually different while it has the 1st wavelength range. A polarization component which is mutually different while it has the 1st wavelength range of the above, and the 2nd different wavelength range. The 1st fixing member which is excitation optical output equipment equipped with the above, and carries out fixing arrangement of the edge of two or more optical fibers for the 1st excitation light which can spread a mutually different polarization component light while this 1st polarization composition section has the 1st wavelength range of the above, The 1st lens assembly which comes to offer the 1st lens changed into a collimation beam from each optical fiber for the 1st excitation light about two or more kinds of polarization component light by which outgoing radiation was carried out, By using the difference in the refractive-index property between two or more above-mentioned kinds of polarization component light by which outgoing radiation was carried out from this 1st lens While the 1st birefringence member which carries out polarization composition and which can carry out outgoing radiation by using two or more above-mentioned kinds of polarization component light as the same optical axis is offered and it is constituted The 2nd fixing member to which this 2nd polarization composition section carries out fixing arrangement of the edge of two or more optical fibers for the 2nd excitation light which can spread a mutually different polarization component light while having the 2nd wavelength range of the above, The 2nd lens assembly which comes to offer the 2nd lens changed into a collimation beam from each optical fiber for the 2nd excitation light about two or more kinds of polarization component light by which outgoing radiation was carried out, the above by which outgoing radiation was carried out from this 2nd lens -- double -- using the difference in the refractive-index property between some kinds of polarization component light -- the above -- double -- it is characterized by having offered the 2nd birefringence member which carries out polarization composition and which can carry out outgoing radiation by using some kinds of polarization component light as the same optical axis, and being constituted
[Claim 14] Excitation optical output equipment according to claim 13 characterized by being constituted so that the light it was multiplexed [light] in this multiplexing section may be used as the object for front excitation to the remote light amplifier connected through the above-mentioned output optical fiber, or an excitation light for back excitation.
[Claim 15] Excitation optical output equipment according to claim 13 characterized by having offered the wavelength demultiplexing section which performs wavelength multiplex or wavelength separation processing, and being constituted between the signal light which included data information while it had different wavelength from the wavelength component of the light it was multiplexed [light] in this multiplexing section, and the above-mentioned light it was multiplexed [light] in this multiplexing section.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001] (Table of contents)
The technical field Prior art to which invention belongs (drawing 11 - drawing 12)
Explanation of the explanation (a) optical transmission device of the 1st operation gestalt of (Gestalt A) of implementation of technical-problem The-means-for-solving-a-technical-problem invention which invention tends to solve (drawing 2)
(b) Explanation of excitation optical output equipment (drawing 1 , 3, 4, 5, 6)
(B) Explanation of the 1st modification of the 1st operation gestalt (drawing 7)
(C) Explanation of the 2nd modification of the 1st operation gestalt (drawing 8)
(D) Explanation of the 3rd modification of the 1st operation gestalt (drawing 9)
(E) Explanation of the 2nd operation gestalt (drawing 10)
(F) In addition, effect-of-the-invention [0002]
[The technical field to which invention belongs] this invention is used for the light amplifier for signal optical amplification in an optical transmission system, and relates to excitation optical output equipment at a suitable polarization synthesizer unit and a suitable polarization decollator row.
[0003]
[Description of the Prior Art] The light amplifier which can be amplified with a lightwave signal is developed without changing a lightwave signal into an electrical signal with development of an optical transmission system in recent years, the optical fiber amplifier using the optical fiber [EDF (Erbium-Doped Fiber:erbium dope fiber)] which doped rare earth elements, such as an erbium (Er), especially has properties, such as high interest profit and low noise, and the important role is played in the optical transmission system.
[0004] Moreover, the WDM (Wavelengh Division Multiplexing : wavelength multiplex) optical-communication method, the TDM (Time Division Multiplexing : Time Division Multiplexing) optical-communication method, etc. are used as a method which transmits and communicates the signal light of a multiple channel simultaneously by one optical fiber. Now, since it becomes high [excitation power required for amplification] as its signal light to amplify increases, although the optical fiber amplifier (a light amplifier is called hereafter) used for a WDM optical-communication method amplifies the input signal wave (signal light) of multiple channels, such as four waves, eight waves, 16 waves, 32 waves, and 64 waves, as a high power output light, the excitation light source of high power is needed.
[0005] In order to attain the high increase in power of such the excitation light source, it is possible to use technique, such as a high increase in power of excitation laser, bidirectional excitation, polarization composition of excitation light, and wavelength composition of excitation light. However, if the optical-circuit device according to it is needed, respectively and constitutes each device in these functional orders in order to realize technique of polarization composition and wavelength composition of excitation light especially, the problem of increase of loss by enlargement of equipment or insertion of an optical-circuit device will occur. Therefore, it is desirable to make the function of the polarization composition about excitation light and the function of wavelength composition unify, to constitute an optical-circuit device (excitation optical output equipment), and to make enlargement of equipment and increase of an insertion loss suppress.
[0006] Although drawing 11 is the plan showing the composition of conventional excitation optical output equipment typically here It is the thing it is made [thing] to multiplex [thing] with the signal light which the excitation optical output equipment shown in this drawing 11 makes excitation light what performed polarization composition and wavelength composition about four kinds of light, and is amplified in EDF. with this excitation optical output equipment The function to which the signal light which should be amplified is made to compound and output to excitation light with the function of polarization composition of excitation light and the function of wavelength

composition like **** was also unified, and it has realized.
[0007] Moreover, the conventional excitation optical output equipment shown in this drawing 11 is equipped with the 1st polarization composition section 51, the 2nd polarization composition section 52, the wavelength multiplex films (WDM) 504 and 505, an isolator 506, the signal light collimators 510e and 520, and a case 501, and is constituted. The 1st polarization composition section 51 is equipped with the polarization composition collimators 510a and 510b, the total reflection optical film (HR:High Reflection Mirror) 502, and the polarization eliminator (PBS:Polarization Beam Splitter) 503, and is constituted.
[0008] Here, as for polarization composition collimator 510a, it comes to fix plane-of-polarization preservation optical fiber 511a and collimate lens 512a, and, as for polarization composition collimator 510b, comes to fix plane-of-polarization preservation optical fiber 511b and KORIME lens 512b similarly. Moreover, these polarization composition collimators 510a and 510b are fixed so that each collimate lenses 512a and 512b may be located inside a case 501, while it is fixed to the periphery section of a case 501, and incidence of the excitation light inputted from each plane-of-polarization preservation optical fibers 511a and 511b is carried out into a case 501 through collimate lenses 512a and 512b, respectively.
[0009] The plane-of-polarization preservation optical fibers 511a and 511b are constituted by the birefringence optical fiber, respectively, and the linearly polarized light which can transmit the light whose wavelength from the excitation light source which is not illustrated is about 1.46 micrometers as the linearly polarized light (light the electric field vector has always turned [light] to the fixed direction), holding plane of polarization, and can spread it by these plane-of-polarization preservation optical fibers 511a and 511b has the electric field vector of mutually different sense. For example, an S wave is made to spread in plane-of-polarization preservation optical fiber 511a, and a primary wave is made to spread in plane-of-polarization preservation optical fiber 511b.
[0010] HR502 is fixed so that total reflection of the light by which incidence was carried out may be carried out and the excitation light of the S wave with a wavelength of 1.46 micrometers inputted from polarization collimator 510a may carry out outgoing radiation towards PBS503. PBS503 carries out total reflection of the light (wavelength of 1.46 micrometers) of the S wave by which incidence is carried out through polarization composition collimator 510a to collimate lens 512a while it has the property in which the permeability changes with plane of polarization (the oscillating direction) of the light by which incidence is carried out and makes the light (wavelength of 1.46 micrometers) of the primary wave from polarization composition collimator 510b all penetrate. Moreover, it is fixed that it should multiplex so that PBS503 may serve as the same optical axis in the excitation light of the S wave from above-mentioned polarization composition collimator 510a, and the excitation light of the primary wave from polarization composition collimator 510b (polarization composition), and the excitation light by which polarization composition was carried out carries out outgoing radiation to WDM504.
[0011] On the other hand, the 2nd polarization composition section 52 as well as the 1st polarization composition section 51 is equipped with the polarization composition collimators 510c and 510d, and HR507 and PBS508, and is constituted. While it is fixed to the periphery section of a case 501, these polarization collimators 510c and 510d It is fixed so that each collimate lenses 512c and 512d may be located inside a case 501, and incidence of the excitation light inputted from each plane-of-polarization preservation optical fibers 511c and 511d is carried out into a case 501 through collimate lenses 512c and 512d, respectively.
[0012] The wavelength from the excitation light source which the plane-of-polarization preservation optical fibers 511c and 511d are also constituted by the birefringence optical fiber, respectively, and is not illustrated has the electric field vector of the sense from which the linearly polarized light which can transmit the light which is about 1.48 micrometers as the linearly polarized light (light the electric field vector has always turned [light] to the fixed direction), and can spread it by these plane-of-polarization preservation optical fibers 511c and 511d while holding plane of polarization differs mutually. For example, an S wave is made to spread in plane-of-polarization preservation optical fiber 511c, and a primary wave is made to spread in 511d of plane-of-polarization preservation optical fibers.
[0013] HR507 is also fixed so that total reflection of the light by which incidence was carried out may be carried out like HR502 and the excitation light of the S wave with a wavelength of 1.48 micrometers inputted from polarization collimator 510c may carry out outgoing radiation towards PBS508. Moreover, PBS508 also carries out total reflection of the light (wavelength of 1.48 micrometers) of the S wave from polarization composition collimator 510c, while having the property in which the permeability changes like PBS503 with plane of polarization (the oscillating direction) of the light by which incidence is carried out and making the light (wavelength of 1.48 micrometers) of the primary wave from polarization composition collimator 510d all penetrate.
[0014] Moreover, it is fixed that it should multiplex so that it may become the same optical axis about the excitation light of the S wave from above-mentioned polarization composition collimator 510c, and the excitation light of the primary wave from polarization composition collimator 510d (polarization composition), and PBS508 passes WDM504 and WDM505, and carries out incidence of the excitation light by which polarization composition was

carried out to the signal light collimator 520.
[0015] Although both WDM504,505 is optical films which have the property in which the permeability changes with wavelength of the light by which incidence is carried out and WDM504 makes light with a wavelength of 1.48 micrometers all penetrate By carrying out total reflection of the light with a wavelength of 1.46 micrometers, on the other hand, although WDM505 makes each light with a wavelength [of 1.48 micrometers] by which incidence is carried out from WDM504, and a wavelength of 1.46 micrometers all penetrate Total reflection of the signal light (wavelength is about 1.55 micrometers) by which incidence is carried out from signal light collimator 510e is carried out.
[0016] WDM504 namely, on the optical axis with a wavelength of 1.48 micrometers by which outgoing radiation is carried out towards the signal light collimator 520 from the 2nd polarization composition section 52 (namely, PBS508 shell) of polarization composition light Have an angle in which the signal light collimator 520 is made to turn and reflect the polarization composition light of wavelength with a wavelength of 1.46 micrometers by which incidence is carried out from the 1st polarization composition section (namely, PBS503 shell), and it is arranged. While making polarization composition light with a wavelength of 1.48 micrometers by which incidence is carried out from PBS508 all penetrate After carrying out wavelength multiplex composition of such excitation light by carrying out total reflection of the polarization composition light with a wavelength of 1.46 micrometers by which incidence is carried out from PBS503 so that it may become the same optical axis, WDM505 is passed and incidence is carried out to the signal light collimator 520.
[0017] Moreover, WDM505 carries out outgoing radiation of the signal light (an excitation light component is included) the multiplexing light of excitation light (polarization composition light) with a wavelength of 1.48 micrometers and excitation light (polarization composition light) with a wavelength of 1.46 micrometers is made to multiplex [light] the signal light (wavelength of 1.55 micrometers) by which incidence is carried out (wavelength multiplex), and it was multiplexed [light] from signal light collimator 510e to the signal light collimator 520.
[0018] Like [the signal light collimator 520] the polarization collimators 510a-510d, an optical fiber 521 and a collimate lens 522 are offered, and it is constituted, and while this signal light collimator 520 is also arranged in the periphery section of a case 510, it is arranged so that a collimate lens 522 may be located inside a case 501, and outgoing radiation of the signal light which passed the collimate lens 522 is carried out to an optical fiber 521.
[0019] Signal light collimator 510e like the polarization collimators 510a-510d and the signal light collimator 520 Offer optical fiber 511e and collimate lens 512e, and it is constituted. While being arranged in the periphery section of a case 510, it is arranged so that a collimate lens 512 may be located inside a case 501. By passing collimate lens 512e, the signal light by which incidence was carried out from optical fiber 511e is changed into a collimation beam, and carries out outgoing radiation towards WDM505.
[0020] The isolator 506 is arranged on the optical axis of the signal light by which incidence is carried out towards WDM505 from signal light collimator 510e, and is for preventing resonance of the equipment by reflection of signal light. By such composition, at the same time it inputs signal light into optical fiber 511of signal light collimator 510e e From each excitation laser currently arranged by the polarization collimators 510a-510d, by carrying out incidence of the excitation light to each plane-of-polarization preservation optical fibers 511a-511d While polarization composition of the excitation light of a primary wave with a wavelength of 1.46 micrometers and an S wave is carried out in the 1st polarization composition section 51, in the 2nd polarization composition section 52, polarization composition of the excitation light of a primary wave with a wavelength of 1.48 micrometers and an S wave is carried out, and wavelength multiplex composition of such excitation light is further carried out by WDM504. Moreover, wavelength multiplex composition is carried out and the signal light by which incidence was carried out to the excitation light by which wavelength multiplex was carried out by doing in this way from signal light collimator 510e is outputted to EDF which does not illustrate from the signal light collimator 520.
[0021] Moreover, the polarization composition machine indicated by JP,6-148570,A is known as the polarization composition section which performs polarization composition of excitation light. When the conventional polarization composition machine indicated by this JP,6-148570,A is explained using drawing 12 , drawing 12 is drawing showing the composition typically. As shown in drawing 12 , the birefringence crystals 3 and 6, the convergence nature rod lens 41, the total reflection mirror 5, the input optical fibers 1 and 2, and the transmission fiber 7 are offered, and the conventional polarization composition machine is constituted, compounds each linearly polarized light inputted through the input optical fibers 1 and 2, respectively, and outputs it from the transmission fiber 7.
[0022] Both the birefringence crystals 3 and 6 are 1 axial birefringence crystals, such as a rutile (TiO2) and crystal, and in these birefringence crystals 3 and 6, while the light which polarized in the direction of an optical axis progresses as it is as Tsunemitsu, it progresses in the direction of an optical axis by the light of right-angled polarization changing an angle as an unusual light. The input optical fibers 1 and 2 are connected to the end side of the birefringence crystal 3, respectively. These input optical fibers 1 and 2 are plane-of-polarization preservation fibers spread where the linearly

polarized light from semiconductor laser (not shown) is held. Moreover, the end side of the convergence nature rod lens 41 is connected to the other end side of the birefringence crystal 3, and the total reflection mirror 5 is further stuck on the other end side of the convergence nature rod lens 41. Moreover, the birefringence crystal 6 is also connected to the above-mentioned end side of the convergence nature rod lens 41 together with the birefringence crystal 3, and the transmission fiber 7 is connected to the other end side of this birefringence crystal 6.

[0023] If the linearly polarized light from the semiconductor laser which is not illustrated inputs into the birefringence crystal 3 through the input optical fibers 1 and 2 by such composition, respectively, the incident light from the input optical fibers 1 and 2 will be divided into Tsunemitsu and unusual light, and will carry out incidence to the end side of the convergence nature rod lens 41. After being changed into parallel light by the convergence nature rod lens 41, it reflects on the lens optical axis 8 in the total reflection mirror 5, and again, after each of these incident lights pass the convergence nature rod lens 41, they are inputted into the birefringence crystal 6.

[0024] Although each incident light is again divided into Tsunemitsu and unusual light and the inside of a crystal is progressed in the birefringence crystal 6 Under the present circumstances, each light divided into Tsunemitsu and unusual light in the birefringence crystal 3 In the birefringence crystal 6, shortly, Tsunemitsu progresses the inside of a crystal as an unusual light, and unusual light progresses the inside of a crystal as Tsunemitsu, in the other end side (connection side with the transmission fiber 7) of the birefringence crystal 6, each light is in agreement, and is outputted, and it is compounded by the transmission fiber 7, and is combined.

[0025]

[Problem(s) to be Solved by the Invention] however, with the conventional excitation optical output equipment shown in drawing 11 In the device which each polarization port is required for each of a primary wave and an S wave because of polarization composition of the primary wave in one wavelength, and an S wave, and unified polarization composition and wavelength composition S polarization port by the side of merit and a total of five compound ports of the output port for the output light of excitation light are needed. P polarization port by the side of short wavelength, S polarization port by the side of short wavelength, and a long wave -- P polarization port by the side of merit, and a long wave -- with a mounting size Becoming sizes, such as about L= 90mm and about W= 60mm, a large reduction of a mounting size has the technical problem are unrealizable, only by unifying a function.

[0026] Moreover, with the conventional polarization composition vessel shown in drawing 12 , since it is necessary to arrange the birefringence crystals 3 and 6 in the minute space between the input optical fibers 1 and 2 and the transmission fiber 7, and the convergence nature rod lens 41, and the size of the birefringence crystals 3 and 6 becomes small and an advanced dimensional accuracy is required of the processing and assembly, productivity becomes low and the technical problem that a manufacturing cost is high occurs.

[0027] Furthermore, although optical adhesion is carried out in the assembly and manufacture of the conventional polarization composition machine shown in drawing 12 with the adhesives which do not illustrate between the birefringence crystals 3 and 6 and the transmission fibers 7 In the state where have the property of being inferior to lightfastness since such adhesives are the organic substance, and the light of high power concentrates on one point to a minimum field called the core region of an optical fiber like a light amplifier Are easy to produce damage on adhesives, the technical problem that it is low unreliable also occurs, and it becomes the hindrance at the time of attaining the high increase in power of equipment. Using it in the state of high power originally can say that it is a fatal defect in the light amplifier which is a premise (for example, when four multiplex, the light of the high power of 400mW will concentrate 100mW light on a field with a diameter of about 10 micrometers).

[0028] It was originated in view of such a technical problem, and this invention aims at providing with excitation optical output equipment the polarization synthesizer unit and polarization decollator row which enabled it to attain large reduction-ization of a mounting size by devising in the structure, having the function, and the lightfastness, reliability and manufacture ease demanded as an optical-circuit device from the former.

[0029]

[Means for Solving the Problem] For this reason, the polarization synthesizer unit of this invention according to claim 1 The fixing member which carries out fixing arrangement of the edge of two or more optical fibers which can spread a mutually different polarization component light, While offering the lens assembly which comes to offer the lens changed into a collimation beam from each optical fiber about two or more kinds of polarization component light by which outgoing radiation was carried out By using the difference in the refractive-index property between two or more kinds of polarization component light by which outgoing radiation was carried out from the lens, it is characterized by having offered the birefringence member which carries out polarization composition by having used two or more kinds of polarization component light as the same optical axis, and being constituted.

[0030] The contiguity or monotonous birefringence crystal toward which the crystallographic axis inclined [as opposed to / the travelling direction of light / as a birefringence member] acutely while being constituted that it is made to incline so that it may touch, and fixing arrangement should be carried out is arranged for the edge of each other

in two optical fibers outgoing radiation of the two different light with the plane of polarization plane of polarization and the fixing member crossed at right angles mutually in the polarization synthesizer unit according to claim 1 here can be carried out, and it can constitute (claim 2). In addition, in a polarization synthesizer unit according to claim 2, a fixing member can be constituted by joining two ferrule members which fix each of two optical fibers (claim 3).
[0031] Moreover, in a polarization synthesizer unit according to claim 1, while being constituted that fixing arrangement of the two optical fibers which can carry out outgoing radiation of the two different light in which a fixing member has the plane of polarization which intersected perpendicularly mutually should be carried out in parallel, the birefringence crystal of the shape of a taper the shape and a crystallographic axis cross at right angles to an optical axis as a birefringence member is arranged, and it can constitute (claim 4). Furthermore, in the polarization synthesizer unit of this claim 1 publication, the plane-of-polarization maintenance optical fiber which holds a polarization state and can spread two or more different light with the plane of polarization which intersected perpendicularly mutually can constitute each of two or more optical fibers (claim 5).
[0032] Furthermore, in the polarization synthesizer unit of this claim 1 publication, among two or more plane of incidence in which two or more kinds of polarization component light in a taper-like birefringence crystal carries out incidence, while the vacuum evaporationo of the coupler film is carried out to plane of incidence with a large incident angle, two or more kinds of polarization component light can offer and constitute the monitor section which carries out a monitor in the reflected light on the street by the coupler film (claim 6). In addition, in the polarization synthesizer unit of this claim 6 publication, the monitor section can offer and constitute the photodiode which carries out a monitor about the sum component of two or more kinds of polarization component light (claim 7). Moreover, in the polarization synthesizer unit of this claim 6 publication, the monitor section may offer and constitute two or more photodiodes which carry out a monitor individually about two or more kinds of each polarization component light (claim 8).
[0033] moreover, the polarization decollator of this invention about two or more kinds of mutually different polarization components contained in the light by which outgoing radiation was carried out from one optical fiber While offering the birefringence member which may be divided into the polarization component light of a kind by using the difference in the refractive-index property between two or more kinds of polarization component light The lens changed into a collimation beam from the birefringence member about the polarization component light by which outgoing radiation was carried out, It is characterized by having offered the lens assembly which comes to offer the fixing member which carries out fixing arrangement of the edge of the optical fiber which can spread each of two or more kinds of polarization component light collimated with the lens, and being constituted (claim 9).
[0034] Furthermore, the excitation optical output equipment of this invention offers the polarization composition section compounded about polarization component light which is mutually different while it has the same wavelength range. The fixing member which carries out fixing arrangement of the edge of two or more optical fibers which can spread the polarization component light from which it is excitation optical output equipment which may output the light compounded in the polarization composition section as an excitation light for optical amplification, and the polarization composition section differs mutually, By using the difference in the refractive-index property between two or more kinds of polarization component light by which outgoing radiation was carried out to the lens assembly which comes to offer the lens changed into a collimation beam from each optical fiber about two or more kinds of polarization component light by which outgoing radiation was carried out from the lens By using two or more kinds of polarization component light as the same optical axis, polarization composition is carried out and it is characterized by having offered the birefringence member which can carry out outgoing radiation in parallel with one different output optical fiber from two or more optical fibers, and being constituted (claim 10).
[0035] In addition, in excitation optical output equipment according to claim 10, it can constitute so that the light compounded in the polarization composition section may be used as the object for front excitation to the remote light amplifier connected through the output optical fiber, or an excitation light for back excitation (claim 11). Moreover, in excitation optical output equipment according to claim 10, you may offer and constitute the wavelength demultiplexing section which performs wavelength multiplex or wavelength separation processing between signal light including data information, having different wavelength from the light compounded in the polarization composition section, and the light compounded in the polarization composition section (claim 12).
[0036] Moreover, the 1st polarization composition section which can be compounded about the 1st excitation light which has a polarization component which is mutually different while the excitation optical output equipment of this invention has the 1st wavelength range, The 2nd polarization composition section which can be compounded about the 2nd excitation light which has a polarization component which is mutually different while it has the 1st wavelength range and the 2nd different wavelength range, The multiplexing section which multiplexs each excitation light by which outgoing radiation was carried out in 2 polarization composition section is offered. the [the 1st polarization composition section and] -- It is excitation optical output equipment which may output the light it was multiplexed [light] in the multiplexing section as an excitation light for optical amplification through an output optical fiber. The

1st fixing member to which the 1st polarization composition section carries out fixing arrangement of the edge of two or more optical fibers for the 1st excitation light which can spread a mutually different polarization component light while having the 1st wavelength range, The 1st lens assembly which comes to offer the 1st lens changed into a collimation beam from each optical fiber for the 1st excitation light about two or more kinds of polarization component light by which outgoing radiation was carried out, By using the difference in the refractive-index property between two or more kinds of polarization component light by which outgoing radiation was carried out from the 1st lens While the 1st birefringence member which carries out polarization composition and which can carry out outgoing radiation by using two or more kinds of polarization component light as the same optical axis is offered and it is constituted The 2nd fixing member to which the 2nd polarization composition section carries out fixing arrangement of the edge of two or more optical fibers for the 2nd excitation light which can spread a mutually different polarization component light while having the 2nd wavelength range, The 2nd lens assembly which comes to offer the 2nd lens changed into a collimation beam from each optical fiber for the 2nd excitation light about two or more kinds of polarization component light by which outgoing radiation was carried out, By using the difference in the refractive-index property between two or more kinds of polarization component light by which outgoing radiation was carried out from the 2nd lens, it is characterized by having offered the 2nd birefringence member which carries out polarization composition and which can carry out outgoing radiation by using two or more kinds of polarization component light as the same optical axis, and being constituted (claim 13).

[0037] In addition, in excitation optical output equipment according to claim 13, you may constitute the light it was multiplexed [light] in the multiplexing section so that it may use as an excitation light for front excitation to the remote light amplifier connected through the output optical fiber (claim 14). Moreover, in excitation optical output equipment according to claim 13, the wavelength demultiplexing section which performs wavelength multiplex or wavelength separation processing can also be offered and constituted between signal light including data information, having different wavelength from the wavelength component of the light it was multiplexed [light] in the multiplexing section, and the light it was multiplexed [light] in the multiplexing section (claim 15).

[0038]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

(A) Although the explanatory drawing 2 of the explanation (a) optical transmission device of the 1st operation gestalt is drawing showing typically the composition of the optical transmission system which applied the excitation optical output equipment as the 1st operation gestalt of this invention The excitation optical output equipment as the 1st operation gestalt of this invention As shown in this drawing 2 , for example, the optical transmission system which it is applied to the optical transmission device in the optical transmission system which performs optical communication between the land which faced across the sea, and is shown in this drawing 2 It has an optical transmission device 1001 (transmitting-side terminal office), an optical transmission device 1002 (receiving-side terminal office), and the remote amplifier 740,750, and is constituted.

[0039] An optical transmission device 1001 offers a signal (Laser Diode : laser diode) LD 810, the post amplifier 820, excitation optical output equipment 2000, and LD200 for excitation, and is constituted. The wavelength multi-processing of signal light including the data information generated by the signal LD 810, and excitation light with a wavelength of about 1.48 micrometers outputted from LD200 for excitation and excitation light with a wavelength of about 1.46 micrometers is performed. Back excitation is performed to the remote amplifier 740 (remote light amplifier).

[0040] Moreover, an optical transmission device 1002 offers light-receiving (Photo Diode : photodiode) PD 370, a preamplifier 380, the excitation light decollator 3000, and LD780 for excitation, and is constituted. While excitation light with a wavelength of about 1.48 micrometers outputted from LD200 for excitation and excitation light with a wavelength of about 1.46 micrometers perform front excitation to the remote amplifier 750 (remote light amplifier) Wavelength separation processing is performed to the light which received, and signal light including data information is made to separate.

[0041] It is the light amplifier of simple composition of it being arranged in a position in the middle of super-long-distance transmission systems, such as a submarine cable, and consisting of only EDF (Erbium-Doped Optical Fiber:erbium dope optical fiber), and both the remote amplifier 740,750 is constituted without offering an electrical circuit, and is electric supply needlessness. It is inputted into excitation optical output equipment 2000, after the signal light transmitted in an optical transmission device 1001 by such composition is inputted into the postamplifier 820 from a signal LD 810 and is amplified with this post amplifier 820. Moreover, after excitation light is inputted into excitation optical output equipment 2000 and being simultaneously multiplexed in signal light and excitation light in this excitation optical output equipment 2000 from LD200 for excitation, back excitation is performed by transmitting to the remote amplifier 740. After signal light is amplified with this remote amplifier 740, it is transmitted to the remote

amplifier 750.
[0042] On the other hand, in an optical transmission device 1002, excitation light is inputted into the excitation light decollator 3000 from LD200 for excitation, and front excitation is performed by transmitting excitation light to the remote amplifier 750 from this excitation light decollator 3000. After signal light is amplified with the remote amplifier 750, it is transmitted to the excitation light decollator 3000. In the excitation light decollator 3000, after dissociating with excitation light and amplifying signal light by the preamplifier 380, it is changed into an electrical signal in light-receiving PD 370.
[0043] In the above optical transmission devices, in case 50km distance is transmitted using the optical fiber whose transmission loss is 0.2dB/km, although 10dB attenuation arises, usually About the signal light which should be transmitted, from the excitation optical output equipment 2000 and the excitation light decollator 3000 which are mentioned later The loss of the signal light in a transmission line can be compensated by amplifying with the remote amplifier 740,750 formed in the remote place using the excitation light of low loss by which polarization composition and wavelength composition (wavelength multiplex) were made.
[0044] (b) It is at explanation of excitation optical output equipment and the time, and the above-mentioned optical transmission device 1001 has composition as shown in drawing 3 in detail. Here, in the optical transmission device 1001 shown in drawing 3 , excitation optical output equipment 2000 offers excitation photosynthesis section 100a-1,100a-2, a case 4, a signal input part 80, the signal light outgoing radiation section 70, and LD 210-240 for excitation, and is constituted (the same sign as drawing 2 shows the same portion in drawing 3).
[0045] Excitation photosynthesis section 100a-1,100a-2, a signal input part 800, and the signal light outgoing radiation section 70 are arranged in the outer wall section of a case 4, and the synthetic membrane 45 and the WDM film 46 are arranged in the interior of a case 4. A signal input part 80 offers the signal collimator 800, the signal light LD 810, a light amplifier (post amplifier) 820, light-receiving PD 830, and an optical fiber 821,831, and is constituted.
[0046] The signal light LD 810 which outputs the signal light (for example, the 1st operation gestalt signal light with a wavelength of about 1.55 micrometers) which the light amplifier 820 is arranged in the end section of an optical fiber 821, and included data information in this light amplifier 820 is connected. After signal light including the data information outputted by this signal light LD 810 is amplified by the light amplifier 820, incidence of it is carried out to the signal collimator 800 through an optical fiber 821.
[0047] The signal collimator 800 offers a ferrule 801, a collimate lens 802, a lens holder 804, and the coupler film 803, and is constituted, and the other end of an optical fiber 821 and the end section of an optical fiber 831 have fixed the ferrule 801 in parallel. The collimate lens 802 which collimates signal light is arranged in the downstream (case 4 side) position of a ferrule 801, and the coupler film 803 is further arranged in the downstream position of a collimate lens 802. This coupler film 803 reflects a part of signal light by which incidence was carried out. In addition, the optical fiber 821,831 is arranged at equal intervals on both sides of the medial axis of a collimate lens 802, incidence of a part of signal light reflected by the coupler film 803 is carried out to an optical fiber 831, and incidence is carried out to a photo coupler 830 through this optical fiber 831.
[0048] A lens holder 804 consists of a stainless steel pipe etc., and fixes a ferrule 801, a collimate lens 802, and the coupler film 803. Fixing arrangement is carried out by meanses, such as welding, through the spacer 805 at the case 4, signal light is turned in a case 4 and the signal collimator 800 carries out outgoing radiation. Moreover, an isolator 890 is arranged in the attaching position of the signal collimator 800 in a case 4, and resonance of the equipment by the reflection of signal light by which outgoing radiation was carried out towards the case 4 from the signal collimator 800 is prevented.
[0049] The signal light outgoing radiation section 70 outputs the excitation light and signal light which were compounded in the case 4 to the transmission-line fiber 290, offers a ferrule 71, a collimate lens 73, and a lens holder 72, and is constituted. The ferrule 71 is arranged so that the end section may have fixed and the medial axis may be located in output signal Mitsukami to whom outgoing radiation of the collimate lens 73 is carried out from the interior of a case 4 (WDM film 46), and it collimates the output signal light injected from the WDM film 46, and it carries out outgoing radiation to the transmission-line fiber 290 so that the end section of the transmission-line fiber 290 may be located on the medial axis of a collimate lens 73.
[0050] While a lens holder 72 consists of a stainless steel pipe etc. and fixing a ferrule 71 and a collimate lens 73, the signal light outgoing radiation section 70 is fixed to a case 4, and the signal light injection section 70 is arranged so that the collimate lens 73 medial axis may be located on the medial axis of excitation photosynthesis section 100a-2 at the outer wall section of a case 4.
[0051] When here explains the polarization synthesizer unit as excitation photosynthesis section 100a-1,100a-2 in this equipment, i.e., the 1st operation gestalt of this invention, using drawing 1 , drawing 1 is the cross section showing typically the composition of the polarization synthesizer unit as the 1st operation gestalt of this invention. Excitation photosynthesis section 100a-1 is what functions as the 1st polarization composition section which can be compounded

about the 1st excitation light which has a polarization component which is mutually different while it has the 1st wavelength range. The plane-of-polarization preservation fibers (PMF) 211 and 221 which are two optical fibers which can spread the polarization component light which intersects perpendicularly mutually are connected to this excitation photosynthesis section 100a-1. LD210,220 for excitation which outputs excitation light with a wavelength of 1.46 micrometers which is the 1st wavelength range is connected to these other end of PMF211 and PMF221, respectively.
[0052] Moreover, excitation photosynthesis section 100a-2 are what functions as the 2nd polarization composition section which can be compounded about the 2nd excitation light which has a polarization component which is mutually different while it has the 1st wavelength range and the 2nd different wavelength range. PMF 211 and 221 which are two optical fibers which can spread the polarization component light which intersects perpendicularly also with these excitation photosynthesis section 100a-2 mutually is connected. LD230,240 for excitation which outputs excitation light with a wavelength of 1.48 micrometers which is the 2nd wavelength range is connected to these other end of PMF211 and PMF221, respectively.
[0053] As excitation photosynthesis section 100a-1 is shown in drawing 1 , lens assembly 110a-1, birefringence crystal 120a-1, and a lens holder 130 are offered, and it is constituted, and lens assembly 110a-1 offers ferrule 111a-1 and a collimate lens 112-1, and it is constituted. ferrule 111a-1 carries out fixing arrangement of the edge of PMF211,221, as it is a member the 1st **** and is shown in drawing 1 So that a different light with the plane of polarization which intersected perpendicularly mutually may be injected PMF211,221 It is made to incline so that the edge may approach or touch each other (angle theta), fixing arrangement is carried out (for example, the 1st operation gestalt theta= 6 degrees), and PMF211,211 becomes an axial symmetry to the medial axis of a collimate lens 112-1 in this case.
[0054] this ferrule 111a-1 is shown in drawing 6 (a) - (c) -- as -- two ferrules -- it is constituted by joining half-segmented ferrule 111a-11,111a-12 which are a member, and these ferrule 111a-11,111a-12 are formed with the ceramic etc. Moreover, hole 111a-15 which fix PMF211 are formed in half-segmented ferrule 111a-11, and hole 111a-15 which fix PMF221 also to half-segmented ferrule 111a-12 are formed similarly.
[0055] As the technique of forming these hole 111a-15 in half-segmented ferrule 111a-11,111a-12, a ceramic is made to sinter putting in the wire of the diameter of said mostly with PMF211,221 at the time of fabrication of half-segmented ferrule 111a-11,111a-12, and the technique formed by drawing out a wire after that can be considered. Collimate lens 112a-1 is the 1st lens changed into a collimation beam from PMF140,141 about two kinds of polarization component light by which outgoing radiation was carried out, respectively. By (for example, the 1st operation gestalt, with a diameter of 2.5mm sphere lens) and this collimate lens 112a-1 It is arranged in the downstream (drawing 1 Nakamigi side) position of ferrule 111a-1 so that two excitation light by which incidence was carried out, respectively may turn into parallel light from PMF211,221 mutually [after passing collimate lens 112a-1].
[0056] Birefringence crystal 120a-1 is 1 axial birefringence crystals, such as a rutile (TiO2) and a calcite. By having the special feature that the refractive index changes with oscillating directions (plane of polarization) of the light to the crystallographic axis, and using the difference in the refractive-index property between two or more kinds of polarization component light injected from a collimate lens 112-1 It functions as the 1st birefringence member which carries out polarization composition by using two or more of these kinds of polarization component light as the same optical axis.
[0057] Namely, when the light (excitation light) which has two kinds of polarization components by which outgoing radiation is carried out from PMF211,221, respectively passes this birefringence crystal 120a-1, Since the refractive index is small, the light (Tsunemitsu) which has the plane of polarization which intersects perpendicularly with the crystallographic axis v of birefringence crystal 120a-1 has a high refractive index, and the light (unusual light) in which the rectilinear-propagation nature has plane of polarization parallel to the crystallographic axis v of birefringence crystal 120a-1 highly changes an angle a lot, and passes it.
[0058] Moreover, birefringence crystal 120a-1 is the monotonous birefringence crystal toward which the crystallographic axis v inclined acutely to the travelling direction of the light by which incidence is carried out, and it is arranged in the downstream (drawing 1 Nakamigi side) position of a collimate lens 112-1. Shaft-orientations length L of this collimate lens 112 of birefringence crystal 120a-1 The angle theta to the shaft of the collimate lens 112-1 of PMF211,221 (the 1st operation gestalt 6 degrees) It is what is defined with the interval D at the time of each light carrying out incidence to birefringence crystal 120a-1 (for example, the 1 operation gestalt 0.4mm). In case each light by which incidence was carried out to birefringence crystal 120a-1 carries out outgoing radiation from the opposite side of birefringence crystal 120a-1, it has length (for example, the 1st operation gestalt 4mm) it is multiplexed [length] by the same optical axis.
[0059] As opposed to the travelling direction of the light which carries out incidence of the crystallographic axis v of birefringence crystal 120a-1 in the operation gestalt shown in drawing 1 In addition, an acute angle It inclines in 45-degree) by (for example, the 1st operation gestalt. this crystallographic axis v While intersecting perpendicularly with the plane of polarization of PMF221, they are the plane of polarization of PMF211, and parallel. The light by which

incidence is carried out from PMF211 passes through the inside of a-birefringence crystal 1201 as an unusual light (refer to sign in drawing 1 e), and, on the other hand, the light by which incidence is carried out from PMF221 passes through the inside of a-birefringence crystal 1201 as Tsunemitsu (refer to sign in drawing 1 o).
[0060] A lens holder 130 consists of a stainless steel pipe etc., and fixes ferrule 111a-1, a collimate lens 112-1, and birefringence crystal 120a-1. This lens holder 130, a collimate lens 112-1, and birefringence crystal 120a-1 have fixed with a low melting glass, adhesives, etc., and this lens holder 130 and ferrule 111a-1 fix them by meanses, such as welding, after carrying out focus control with a collimate lens 112-1.
[0061] Thereby, the light (excitation light) injected by PMF211,221 from LD210,220 for excitation is in a state with the plane of polarization which intersects perpendicularly mutually, incidence of it is carried out to an equidistant position from the medial axis of a collimate lens 112-1, respectively, turns into a collimation beam light parallel to both the opticals axis of a collimate lens 112-1, and is injected in the end side of birefringence crystal 120a-1.
[0062] In birefringence crystal 120a-1, while the light injected from PMF221 passes through the inside of a-birefringence crystal 1201 by linearity high as Tsunemitsu The light injected from PMF211 passes being greatly refracted as an unusual light in a-birefringence crystal 1201, polarization composition is carried out in the other end side of birefringence crystal 120a-1, and outgoing radiation of such light is carried out as a light of the same optical axis.
[0063] Moreover, through a spacer 105, polarization composition collimator 100a-1 turns the excitation light in which fixing arrangement is carried out by meanses, such as welding, and by which polarization composition was carried out in a case 4, and it carries out outgoing radiation to a case 4. In addition, as a sign with a parenthesis shows in drawing 1 , excitation photosynthesis section 100a-2 have the same composition as excitation photosynthesis section 100a-1, and they can output now what carried out polarization composition as a 1.48-micrometer excitation light as the 2nd wavelength range about the light light and plane of polarization cross at right angles mutually.
[0064] In addition, the 2nd lens and birefringence crystal 120a-2 correspond to the 2nd birefringence member, and, as for PMF241,231, the optical fiber for the 2nd excitation light, and ferrule 111a-2 and a collimate lens correspond [ferrule 111a-2 / the 2nd fixing member and a collimate lens 112-2] to the 2nd lens assembly, respectively. Moreover, through a spacer 105, polarization composition collimator 100a-2 turn the excitation light in which fixing arrangement is carried out by meanses, such as welding, and by which polarization composition was carried out in a case 4, and they carry out outgoing radiation to a case 4.
[0065] In the excitation optical output equipment 2000 shown in drawing 3 by the way, a synthetic membrane 45 The optical axis of the excitation light with a wavelength of 1.48 micrometers by which functions as the multiplexing section which multiplexs each excitation light by which outgoing radiation was carried out in excitation photosynthesis section 100a-1 and excitation photosynthesis section 100a-2, and outgoing radiation is carried out from excitation photosynthesis section 100a-1 and by which polarization composition was carried out, It is fixed so that the reflector may be located in an intersection with the optical axis of the excitation light with a wavelength of 1.46 micrometers by which outgoing radiation is carried out from excitation photosynthesis section 100a-2 and by which polarization composition was carried out. Moreover, it has an angle in which the excitation light by which outgoing radiation is carried out is reflected towards the core of the collimate lens 73 in the signal light outgoing radiation section 70 from excitation photosynthesis section 100a-1, and is fixed.
[0066] Drawing 5 (a) and (b) are drawings for explaining the transparency property of a synthetic membrane 45 and the WDM film 46, respectively, drawing 5 (a) is drawing showing the relation of the wavelength and the permeability in a synthetic membrane 45, and drawing 5 (b) is drawing showing the relation of the wavelength and the permeability in the WDM film 46. A synthetic membrane 45 is an optical film which has the property in which the permeability changes with wavelength of the signal light by which incidence is carried out, and as shown in drawing 5 (a), while it all penetrates light with a wavelength of 1.46 micrometers, it has the property which carries out total reflection of the light with a wavelength of 1.48 micrometers. That is, while a synthetic membrane 45 makes the excitation light with a wavelength of 1.46 micrometers by which outgoing radiation is carried out from excitation photosynthesis section 100a-2 by which polarization composition was carried out all penetrate, total reflection is carried out in the excitation light with a wavelength of 1.48 micrometers by which outgoing radiation is carried out from excitation photosynthesis section 100a-1 by which polarization composition was carried out, it has come to be able to carry out outgoing radiation to the WDM film 46 as the same optical axis as such excitation light, and, thereby, it multiplexs an above-mentioned excitation light
[0067] Moreover, it is the optical film which has the property in which the permeability changes like a synthetic membrane 45 with wavelength of the signal light by which incidence is carried out, and the WDM film 46 also makes light with a wavelength of 1.55 micrometers all penetrate, while carrying out total reflection of the wavelength of 1.46 micrometers, and the 1.48-micrometer light, as shown in drawing 5 (b). That is, wavelength multiplex [of the WDM film 46] is carried out to the wavelength of 1.46 micrometers and the 1.48-micrometer excitation light it was

multiplexed [light] by the synthetic membrane 45 about signal light with a wavelength [from the signal collimator 800] of 1.55 micrometers, and it functions on them as the wavelength demultiplexing section.
[0068] Thereby, in the optical transmission device 1001 concerning the 1st operation gestalt, wavelength multiplex transmission of the excitation light for remote amplifier 740 excitation (polarization composition and wavelength multiplex are carried out) can be carried out now with the signal light generated by the signal LD 810. In addition, the transmission-line fiber 290 is for being laid by the seabed for example, between continents etc. and performing the exchange of a lightwave signal through the remote amplifier 740,750 between an optical transmission device 1001 and an optical transmission device 1002.
[0069] Then, the composition of the excitation light decollator 3000 in the optical transmission device 1002 shown in drawing 2 is explained using drawing 4 . Although drawing 4 is the cross section showing the detailed composition of an optical transmission device 1002 typically, it differs in that replaced with the signal input part 80 the excitation light decollator 3000 of the optical transmission device 1002 shown in this drawing 4 as compared with the excitation optical output equipment 2000 in the above-mentioned 1001 in an optical transmission, and the signal output part 90 is offered. Specifically, the excitation light decollator 3000 has the same composition as excitation optical output equipment 2000 except for the sense of an isolator (890,990), and other portions are constituted like the excitation optical output equipment 2000 shown in drawing 3 .
[0070] In addition, among drawing, since the portion the same [the same sign as a sign as stated above] or almost same is shown, the explanation is omitted. Moreover, although the excitation light decollator 3000 shown in drawing 4 has offered demarcation membrane 45' and signal light incidence section 70', it is the same as that of the synthetic membrane 45 and the signal injection section 70 in the excitation optical output equipment 2000 shown in drawing 3 respectively, and also omits the explanation about these composition. [of these]
[0071] A signal output part 90 offers the signal collimator 900, a light amplifier (preamplifier) 380, light-receiving PD 370, and an optical fiber 371, and is constituted. Fixing arrangement is carried out by meanses, such as welding, through the spacer 905 at the case 4, and an isolator 890 is arranged in the attaching position of the signal collimator 900 in a case 4, and the signal collimator 900 prevents resonance of the equipment produced when the signal light by which outgoing radiation was carried out towards the signal collimator 900 reflects.
[0072] Moreover, the signal collimator 900 offers a ferrule 901, a collimate lens 902, and a lens holder 904, and is constituted, and the ferrule 901 has fixed the end section of an optical fiber 371 according to the medial axis of a collimate lens 902. The light amplifier 380 is arranged in the other end side of an optical fiber 371, light-receiving PD 370 is arranged in this light amplifier 380, and incidence of the signal light amplified by light amplifier 380 is carried out to light-receiving PD 370.
[0073] Moreover, the collimate lens 902 which changes signal light into a collimation beam is arranged in the upstream (case 4 side) position of a ferrule 901. A lens holder 904 consists of a stainless steel pipe etc., and fixes a ferrule 901 and a collimate lens 902. Operation of the 1st operation gestalt of this invention by above-mentioned composition is explained below. First, with the signal light LD 810 of an optical transmission device 1001, after carrying out outgoing radiation of the signal light including data information to a light amplifier 820 and amplifying the signal light of a light-amplifier 820 smell lever, incidence is carried out to the signal collimator 800 through an optical fiber 821.
[0074] First, incidence of the signal light by which incidence was carried out to the signal collimator 800 is carried out to a collimate lens 802, and it is changed into a collimation beam and carries out incidence to the coupler film 803 with a predetermined incident angle. Here, it is reflected on a front face and incidence of some components of the signal light by which incidence was carried out to the coupler film 803 is carried out to a photo coupler 830 through an optical fiber 831. On the other hand, after passing the coupler film 803 and passing along an isolator 890 about the component of **, incidence is carried out to the WDM film 46.
[0075] In addition, in a photo coupler 830, by controlling the signal light LD 810 by the signal light control unit which carries out the monitor of a part of this signal light, and does not illustrate it, the optical level of signal light can be maintained uniformly and a reliable optical transmission device can be built. Moreover, outgoing radiation of the excitation light is carried out to PMF 211-241 by LD 210-240 for excitation, respectively at the same time it carries out incidence of the signal light by the signal light LD 810.
[0076] Here, two LD210,220 for excitation both carries out incidence of the excitation light (the 1st excitation light) with a wavelength of 1.46 micrometers to excitation photosynthesis section 100a-1 through PMF 211 and 221. By passing PMF211,221, the excitation light in which outgoing radiation was carried out by LD210,220 for excitation turns into polarization component light which intersects perpendicularly mutually, and carries out incidence to excitation photosynthesis section 100a-1.
[0077] After polarization composition is carried out as the same optical axis in excitation photosynthesis section 100a-1, outgoing radiation of the excitation light of two 1.46-micrometer wavelength which is the polarization component light which intersects perpendicularly mutually by which outgoing radiation was carried out from LD 210 and 220 for

excitation, respectively is carried out towards a synthetic membrane 45. On the other hand, by passing PMF231,241, LD 230 and 240 for excitation serves as polarization component light which intersects perpendicularly mutually, and carries out incidence of the excitation light in which both carried out incidence of the excitation light (the 2nd excitation light) with a wavelength of 1.48 micrometers to excitation photosynthesis section 100a-2 through PMF 231 and 241, and outgoing radiation was carried out by this LD230,240 for excitation to excitation photosynthesis section 100a-2.

[0078] Moreover, the excitation light of two 1.48-micrometer wavelength which is the polarization component light which intersects perpendicularly mutually is also injected towards the signal light injection section 70, after polarization composition is carried out as a coaxial optical axis in excitation photosynthesis section 100a-2. Incidence of the excitation light with a wavelength of 1.48 micrometers by which outgoing radiation was carried out from excitation photosynthesis section 100a-2 by which polarization composition was carried out is carried out from the end side (left lateral in drawing 3) in a synthetic membrane 45, and it all penetrates this synthetic membrane 45.

[0079] On the other hand, the excitation light with a wavelength of 1.46 micrometers by which outgoing radiation was carried out from excitation photosynthesis section 100a-1 by which polarization composition was carried out It is multiplexed so that it may become the same optical axis as the excitation light with a wavelength of 1.48 micrometers by which carried out incidence to the other end side (the drawing 3 Nakamigi side) of a synthetic membrane 45, total reflection was carried out on the front face of this synthetic membrane 45, and outgoing radiation was carried out from excitation photosynthesis section 100a-2 by which polarization composition was carried out, and outgoing radiation is carried out towards the signal light injection section 70.

[0080] Thus, although it passes the WDM film 46 while outgoing radiation of the excitation light it was multiplexed [light] being carried out from a synthetic membrane 45 to the signal light outgoing radiation section 70, in this WDM film 46, wavelength multiplex composition of it is carried out with the signal light by which outgoing radiation was carried out from the above-mentioned signal collimator 800. That is, incidence of the excitation light (excitation light with a wavelength of 1.46 micrometers and excitation light with a wavelength of 1.48 micrometers) it was multiplexed [light] is carried out from the end side (left lateral in drawing 3) of the WDM film 46, and it all penetrates this WDM film 46.

[0081] On the other hand, incidence of the signal light by which outgoing radiation was carried out from the signal collimator 800 is carried out to the other end side of the WDM film 46, total reflection is carried out on the front face of this WDM film 46, wavelength multiplex composition is carried out so that it may become the same optical axis as the excitation light which all penetrates the WDM film 46 and it was multiplexed [light], and incidence of it is carried out to the signal light injection section 70. After the wavelength multiplex light of the excitation light by which incidence was carried out to the signal light injection section 70, and signal light is changed into a collimation beam by passing a collimate lens 73, outgoing radiation of it is carried out to the transmission-line fiber 290 as optical transmission device 1001 output. This wavelength multiplex light is inputted into the remote amplifier 740 through the transmission-line fiber 290, the excitation light of the signal light which constitutes wavelength multiplex light, and the excitation light is used as an excitation light for front excitation in this remote amplifier 740, and signal light is amplified.

[0082] Furthermore, the signal light amplified with the remote amplifier 740 is sent to the remote amplifier 750 through the transmission-line fiber 290, and further, in this remote amplifier 750, after being amplified by the excitation light for the back excitation from the excitation light decollator 3000 (polarization composition and wavelength multiplex are carried out), it is transmitted to an optical transmission device 1002.

[0083] Moreover, incidence of the signal light amplified with the remote amplifier 750 is carried out to the collimate lens 73 of the signal light injection section 70 in an optical transmission device 1002 through the transmission-line fiber 290, and incidence is carried out to the WDM film 46 as a collimation beam by passing this collimate lens 73. Among the light by which incidence was carried out to this WDM film 46, total reflection of the signal light with a wavelength of 1.55 micrometers is carried out on the front face of the WDM film 46, and outgoing radiation is carried out towards the signal collimation 900. After signal light with a wavelength [this] of 1.55 micrometers by which total reflection was carried out passes along an isolator 990, incidence of it is carried out to a collimate lens 902, and after being changed into a collimation beam by passing this collimate lens 902, incidence of it is carried out to an optical fiber 371.

[0084] After signal light with a wavelength of 1.55 micrometers by which incidence was carried out to the optical fiber 371 is amplified by light amplifier 380, recovery conversion is carried out by light-receiving PD 370, and it is used for an electrical signal as data information in a latter signal-processing system. In this equipment, from LD 210-240 for excitation like the above-mentioned excitation optical output equipment 2000 moreover, by carrying out outgoing radiation of the excitation light to PMF 211-241, respectively While carrying out polarization composition of the excitation light with a wavelength of 1.46 micrometers in excitation photosynthesis section 100a-1 After carrying out polarization composition of the excitation light with a wavelength of 1.48 micrometers in excitation photosynthesis

section 100a-2 and carrying out wavelength multiplex composition of such excitation light by which polarization composition was carried out in a synthetic membrane 45, outgoing radiation is carried out to the transmission-line fiber 290 from signal light incidence section 70'. This excitation light is inputted into the remote amplifier 750 through the transmission-line fiber 290, and carries out back excitation of the remote amplifier 750.

[0085] Thus, while carrying out polarization composition of the excitation light with a wavelength of 1.46 micrometers using excitation photosynthesis section 100a-1 according to the excitation optical output equipment as the 1st operation gestalt of this invention With the equipment of simple composition small from the ability of the number of polarization ports to be reduced by compounding excitation light with a wavelength of 1.48 micrometers using excitation photosynthesis section 100a-2 Since polarization composition of the excitation light of each wavelength can be carried out, the whole equipment can be miniaturized, for example, it can constitute from sizes, such as about L= 80mm and about W= 40mm, with a mounting size.

[0086] moreover, use since the whole equipment can be miniaturized and it can consider as simple composition -- low-cost-ization by curtailment of a member can also be attained furthermore, use since the whole equipment can be miniaturized from the ability of wavelength multiplex or wavelength separation to also be performed in the same equipment by offering and constituting the WDM film 46 which performs wavelength multiplex or wavelength separation processing to excitation optical output equipment and it can constitute simply -- low-cost-ization by curtailment of a member can be attained

[0087] Furthermore, according to the polarization synthesizer unit as the 1st operation gestalt of this invention By lens assembly 110a-1 (110a-2) and birefringence crystal 120a-1 (120a-2) Each light by which outgoing radiation is carried out from PMF 211 (241) and 221 (231), respectively by carrying out polarization composition using the difference in the refractive-index property between each polarization component light and also it can realize polarization composition in one port and can attain the miniaturization of a mounting size -- manufacture -- easy -- use -- low-cost-ization by curtailment of a member can be attained

[0088] (B) About excitation photosynthesis section 100a-1,100a-2 (refer to drawing 3) as a polarization synthesizer unit of the optical transmission devices 1001 and 1002 concerning the explanation above-mentioned 1st operation gestalt of the 1st modification of the 1st operation gestalt, excitation optical output equipment 2000, and the excitation light decollator 3000, it can also be used, for example, being able to replace with excitation photosynthesis section 100b as shown in drawing 7 .

[0089] That is, as shown in this drawing 7 , drawing 7 is the cross section showing typically the composition of the 1st modification of the polarization synthesizer unit as the 1st operation gestalt of this invention, and excitation photosynthesis section 100b offers lens assembly 110b, birefringence crystal 120b, and a lens holder 130, and is constituted, and lens assembly 110b offers ferrule 111b and a collimate lens 112, and is constituted.

[0090] In addition, among drawing, since the portion the same [the same sign as a sign as stated above] or almost same is shown, the explanation is omitted. fixing whose ferrule 111b carries out fixing arrangement of the edge of the plane-of-polarization preservation fiber (PMF) 211,221, respectively -- it is a member, and as shown in drawing 1 , the edge of PMF211,221 is fixed in the equidistant position from the medial axis of a collimate lens 112 in parallel so that a different light with the plane of polarization which intersected perpendicularly mutually may be injected

[0091] PMF(s)211,221 are two optical fibers which can spread the polarization component light which intersects perpendicularly mutually, and LD for excitation which is not illustrated is arranged in drawing 1 by the opposite side edge section with polarization synthesizer unit 100b in these PMF(s)211,221, respectively. Collimate lens 112b is a lens which polarizes with a collimation beam about two or more kinds of polarization component light by which the injection molding machine was carried out from PMF211,221, and is arranged in the downstream (drawing 1 Nakamigi side) position of ferrule 111b.

[0092] using the difference in the refractive-index property between two or more kinds of polarization component light which birefringence crystal 120b is 1 axial birefringence crystals, such as a rutile (TiO_2) and a calcite, has the special feature that the refractive index changes with oscillating directions (plane of polarization) of the light to the crystallographic axis, and is injected from a collimate lens 112 -- these -- double -- the birefringence which uses some kinds of polarization component light as the same optical axis, and carries out polarization composition -- it is a member

[0093] That is, in case this birefringence crystal 120b is passed, since the refractive index is small, rectilinear-propagation nature is high, the light (unusual light) which, on the other hand, has plane of polarization parallel to the crystallographic axis v of birefringence crystal 120b has a high refractive index, and the light (Tsunemitsu) which has the plane of polarization which intersects perpendicularly with the crystallographic axis v of birefringence crystal 120b changes an angle a lot, and passes. Moreover, birefringence crystal 120b is the birefringence crystal of the shape of a taper the shape and a crystallographic axis v cross at right angles to an optical axis, and the collimate lens 112 and the field of the side which counters are formed so that it may intersect perpendicularly with PMF211,221. In addition, the

field by the side of the collimate lens 112 of this birefringence crystal 120b is hereafter called a vertical plane.
[0094] On the other hand, the field of an opposite side is formed as a taper side so that it may become a predetermined angle (angle defined with the distance from the medial axis of the collimate lens 112 of PMF211,221, the refractive index of a collimate lens 112, etc.), and in case each light by which incidence was carried out to the plane of incidence of birefringence crystal 120b carries out outgoing radiation to the collimate lens 112 side of this birefringence crystal 120b from the outgoing radiation side of birefringence crystal 120b, it is multiplexed with it by the same optical axis. In addition, the inclined plane of this birefringence crystal 120b is hereafter called a taper side.
[0095] In addition, in the operation gestalt shown in drawing 1 , the light to which incidence of the light by which the crystallographic axis v of birefringence crystal 120b becomes parallel to the plane of polarization of PMF211, and incidence is carried out from PMF211 is carried out from PMF221 as an unusual light passes through the inside of birefringence crystal 120b as Tsunemitsu, respectively. By above-mentioned composition, the light injected by PMF211,221 by LD 210-240 (refer to drawing 3) for excitation is in a state with the plane of polarization which intersects perpendicularly mutually, incidence of it is carried out to equal distance partition ****** from the medial axis of a collimate lens 112, respectively, it turns into collimation beam light, has a predetermined outgoing radiation angle, and is injected by the vertical plane of birefringence crystal 120b.
[0096] In birefringence crystal 120b, it passes, while the light injected from PMF221 passes through the inside of birefringence crystal 120b by linearity high as Tsunemitsu and the light injected from PMF211 is greatly refracted as an unusual light, and from the taper side of birefringence crystal 120b, polarization composition is carried out as a light of the same optical axis, and outgoing radiation of both light is carried out. Thus, since the same operation effect as the polarization synthesizer unit shown in drawing 1 mentioned above can be acquired according to the 1st modification of the polarization synthesizer unit as the 1st operation gestalt of this invention, and also the composition of ferrule 111b is simple and the manufacture is easy, reduction of a manufacturing cost can be aimed at.
[0097] (C) About excitation photosynthesis section 100a-1,100a-2 (refer to drawing 3) as a polarization synthesizer unit of the optical transmission devices 1001 and 1002 concerning the explanation above-mentioned 1st operation gestalt of the 2nd modification of the 1st operation gestalt, excitation optical output equipment 2000, and the excitation light decollator 3000, it can also be used, for example, being able to replace with excitation photosynthesis section 100c as shown in drawing 8 .
[0098] Drawing 8 is the cross section showing typically the composition of the 2nd modification of the polarization synthesizer unit as the 1st operation gestalt of this invention. namely, excitation photosynthesis section 100c As shown in this drawing 8 , while replacing with the lens holder 130 of polarization synthesizer unit 100b shown in drawing 7 and offering lens-holder 130c Light-receiving PD 150 is offered, further, it replaces with birefringence crystal 120b, birefringence crystal 120c is offered, and other portions are constituted like polarization synthesizer unit 100b shown in drawing 7 .
[0099] In addition, among drawing, since the portion the same [the same sign as a sign as stated above] or almost same is shown, the explanation is omitted. Birefringence crystal 120c has the same composition as birefringence crystal 120of polarization synthesizer unit 100b shown in drawing 7 b, and also Light which the vacuum evaporationo of the coupler film 121 is carried out to plane of incidence with the large incident angle, and carried out incidence to this plane of incidence () That is, it reflects in the coupler film 121 and incidence of a part of sum component of the excitation light from which a polarization component differs mutually which carried out incidence from PMF 211 and 221, respectively is carried out to light-receiving PD 150.
[0100] Like polarization synthesizer unit 100a shown in drawing 1 , and the lens holder 130 of polarization synthesizer unit 100b shown in drawing 7 , although lens-holder 130c is constituted by the stainless steel pipe etc. and fixes ferrule 111b, a collimate lens 112, and birefringence crystal 120c reflection of the excitation light reflected by the coupler film 121 of birefringence crystal 120c in this lens-holder 130c -- a course -- notch 131c is formed in the upper periphery, and light-receiving PD 150 is further arranged in this notch 131c
[0101] After being the photo detector which restores to the light which received light to an electrical signal, functioning as the monitor section which carries out a monitor about the polarization component light reflected by the coupler film 121, receiving the excitation light reflected by the coupler film 121 and getting over to an electrical signal, light-receiving PD 150 is sent to the excitation light control unit which does not illustrate the electrical signal, and carries out a monitor about the sum component of each polarization component light.
[0102] Moreover, this equipment has offered the excitation light control unit which is not illustrated, since the excitation light of the predetermined quantity of light is outputted, it controls LD 210-240 (refer to drawing 3) for excitation, it compares this electrical signal with the reference value beforehand set as the excitation light control unit in response to the electrical signal according to the excitation luminous intensity sent from light-receiving PD 150, and it controls LD 210-240 for excitation so that this electrical signal is in agreement with a reference value.
[0103] The excitation light injected by PMF211,221 by LD 210-240 (refer to drawing 3) for excitation is in a state

with the plane of polarization which intersects perpendicularly mutually, respectively, incidence of it is carried out to parallel with the medial axis of a collimate lens 112 from the medial axis of a collimate lens 112 at equal distance partition ******, it turns into collimation beam light, has a predetermined outgoing radiation angle, and outgoing radiation is carried out to the vertical plane of birefringence crystal 120c by above-mentioned composition.

[0104] In birefringence crystal 120c, it passes, while the light injected from PMF221 passes through the inside of birefringence crystal 120c by linearity high as Tsunemitsu and the light injected from PMF211 is greatly refracted as an unusual light, and from the taper side of birefringence crystal 120c, polarization composition is carried out as a light of the same optical axis, and outgoing radiation of both excitation light is carried out. Moreover, the part is reflected towards light-receiving PD 150 by the coupler film with which the vacuum evaporationo of the excitation light by which polarization composition was carried out as a light of the same optical axis in respect of the taper of birefringence crystal 120c was carried out to the taper side. A part of this reflected excitation light is changed into an electrical signal in light-receiving PD 150, and based on the value of this electrical signal, an excitation light control unit controls LD 210-240 for excitation, respectively, and it supplies the excitation light always stabilized to this equipment.

[0105] Thus, according to the 2nd modification of the polarization synthesizer unit as the 1st operation gestalt of this invention Can acquire the same operation effect as the polarization synthesizer unit shown in drawing 7 mentioned above, and also Since the monitor of the excitation light which was reflected by the coupler film 121 and by which polarization composition was carried out can be carried out by light-receiving PD 150 and the excitation light laser 210-240 can be controlled, respectively Since the lightwave signal of excessive optical level is not sent out to an optical fiber when the stable excitation optical output can be obtained and it uses for an optical transmission device, Relay amplification is cumulatively carried out through a transmission line, other repeaters, etc., and there is no possibility of affecting the quality of optical parts which receives a lightwave signal in a receive section so that excessive output light may not become still larger in the stage which receives a lightwave signal in the terminal office.

[0106] (D) About excitation photosynthesis section 100a-1,100a-2 (refer to drawing 3) as a polarization synthesizer unit of the optical transmission devices 1001 and 1002 concerning the explanation above-mentioned 1st operation gestalt of the 3rd modification of the 1st operation gestalt, excitation optical output equipment 2000, and the excitation light decollator 3000, it can also be used, for example, being able to replace with 100d of excitation photosynthesis sections as shown in drawing 9 .

[0107] Drawing 9 is the cross section showing typically the composition of the 3rd modification of the polarization synthesizer unit as the 1st operation gestalt of this invention. namely, 100d of excitation photosynthesis sections As shown in this drawing 9 , while replacing with lens-holder 130of polarization synthesizer unit 100c shown in drawing 8 c and offering lens-holder 130d Light-receiving PD 150,160 is offered, further, it replaces with birefringence crystal 120c, 120d of birefringence crystals is offered, and other portions are constituted like 100d of polarization synthesizer units shown in drawing 8 .

[0108] In addition, among drawing, since the portion the same [the same sign as a sign as stated above] or almost same is shown, the explanation is omitted. Although no less than 120d of birefringence crystals has offered the same composition as birefringence crystal 120of polarization synthesizer unit 100c shown in drawing 8 c, they are arranged so that the taper side may counter a collimate lens 112.

[0109] Namely, the collimate lens 112 in 120d of birefringence crystals and the field (plane of incidence) of the side which counters It is formed so that it may become a predetermined angle (angle defined with the distance from the medial axis of the collimate lens 112 of PMF211,221, the refractive index of a collimate lens 112, etc.). With the (this field is hereafter called taper side) one side, and collimate lens 112 side of this birefringence crystal 120b, the field (outgoing radiation side) of an opposite side It is formed so that it may intersect perpendicularly with the optical axis of PMF211,221, and it is multiplexed by the same optical axis in case each light by which incidence was carried out to the plane of incidence (taper side) of 120d of birefringence crystals carries out outgoing radiation from the outgoing radiation side (vertical plane) of 120d of birefringence crystals.

[0110] Moreover, it reflects in a coupler film and incidence of a part of each excitation light (namely, excitation light which carried out incidence from PMF 211 and 221, respectively and from which a polarization component differs mutually) which the vacuum evaporationo of the coupler film 121 is carried out to plane of incidence (taper side) with the large incident angle in 120d of birefringence crystals, and carries out incidence to this taper side is carried out to light-receiving 150 and PDs 160, respectively.

[0111] Lens-holder 130d, like the polarization synthesizer unit 100c lens holder 130 shown in drawing 8 It is what is constituted by the stainless steel pipe etc. and fixes ferrule 111b, a collimate lens 112, and birefringence crystal 120c. reflection of each excitation light reflected by the coupler film 121 of 120d of birefringence crystals in this lens-holder 130d -- a course -- 131d of notches is formed in the upper periphery, and light-receiving PD 150,160 is further arranged by 131d of this notch, respectively

[0112] It is the photo detector which restores to the light which received light to an electrical signal, both light-receiving PD 150,160 is the monitor sections which carry out a monitor about the polarization component light reflected by the coupler film 121, and after receiving the excitation light reflected by the coupler film 121, respectively and getting over to an electrical signal, it is sent to the excitation light control unit which does not illustrate the electrical signal.
[0113] In addition, in 100d of polarization synthesizer units shown in drawing 9 , incidence of the excitation light by which outgoing radiation is carried out from PMF211 is carried out to light-receiving PD 160, and, on the other hand, incidence of the excitation light by which outgoing radiation was carried out from PMF221 is carried out to light-receiving PD 150. Moreover, since the excitation light control unit which does not illustrate this equipment, either is offered and the excitation light of the predetermined quantity of light is outputted, LD 210-240 (refer to drawing 3) for excitation is controlled. The reference value beforehand set as the excitation light control unit with this electrical signal in response to the electrical signal according to the excitation luminous intensity sent from light-receiving PD 150,160, respectively is compared, and LD 210-240 for excitation is controlled so that this electrical signal is in agreement with a reference value.
[0114] By above-mentioned composition, the excitation light injected by PMF211,221 by LD 210-240 (refer to drawing 3) for excitation is in a state with the plane of polarization which intersects perpendicularly mutually, respectively, incidence of it is carried out to parallel with the medial axis of a collimate lens 112 from the medial axis of a collimate lens 102 at equal distance partition ******, it turns into collimation beam light, has a predetermined outgoing radiation angle, and is injected in the taper side of 120d of birefringence crystals.
[0115] Each excitation light which carried out incidence to the taper side of 120d of this birefringence crystal Those parts are reflected in this taper side by the coupler film 121 by which vacuum evaporationo was carried out. Incidence is carried out to light-receiving PD 150,160, respectively, and other portions of each excitation light which carried out incidence into 120d of birefringence crystals While the light injected from PMF221 passes through the inside of 120d of birefringence crystals by linearity high as Tsunemitsu The light injected from PMF211 passes being greatly refracted as an unusual light, from the vertical plane of birefringence crystal 120c, polarization composition is carried out as a light of the same optical axis, and outgoing radiation of both excitation light is carried out.
[0116] A part of each excitation light by which incidence was carried out to light-receiving PD 150,160, respectively is sent to the excitation light control unit which is not illustrated after being changed into an electrical signal, and an excitation light control unit controls LD 210-240 for excitation based on the value of these electrical signals, respectively, and supplies the always stabilized excitation light. Thus, according to the 3rd modification of the polarization synthesizer unit as the 1st operation form of this invention Can acquire the same operation effect as the polarization synthesizer unit shown in drawing 8 mentioned above, and also Since the monitor of the two excitation light reflected by the coupler film 121 can be carried out by light-receiving PD 150,160, respectively and the excitation light laser 210-240 can be controlled, respectively Each light source is separately controllable for every polarization component of each excitation light, it is quality and a reliable polarization synthesizer unit can be obtained from the ability of excitation **** control of a high level to be performed more.
[0117] (E) Although the explanatory drawing 10 of the 2nd operation form is a cross section showing typically the composition of the polarization decollator as the 2nd operation form of this invention, this polarization decollator can use it for example, for a polarization diversity receiver. Polarization decollator 100a-1' like [as shown in drawing 10] excitation photosynthesis section 100a-1 shown in drawing 1 Offer lens assembly 110a-1', birefringence crystal 120a-1', and lens-holder 130', and it is constituted. Moreover, lens assembly 110a-1' offers ferrule 111a-1' and collimate lens 112-1', and is constituted. Excitation photosynthesis section 100a-1 shown in drawing 1 carries out polarization separation of the light inputted from birefringence crystal 120a-1 for every polarization component conversely, and it carries out outgoing radiation from PMF211'221'.
[0118] Moreover, in drawing 10 , in order to explain polarization decollator 100a-1', the state where outgoing radiation of the light is carried out to polarization decollator 100a-1' from optical outgoing radiation equipment 104 is shown for convenience. This optical outgoing radiation equipment 104 offers a collimate lens 412, a ferrule 411, and a lens holder 430, and is constituted, the ferrule 411 is carrying out fixing arrangement of the optical fiber 440 on the medial axis of a collimate lens 412, and the lens holder 430 is fixing the collimate lens 412 and the ferrule 411, and by passing a collimate lens 412, the light by which incidence was carried out from the optical fiber 440 serves as a collimation beam, and is injected toward polarization decollator 100a-1'.
[0119] Plane-of-polarization preservation fiber (PMF) 211' and 221' which can spread the polarization component light which intersects perpendicularly mutually and which are two optical fibers are connected to polarization decollator 100a-1', and light-receiving PD 310,320 (refer to drawing 4) is arranged by the other end of these PMF211' and PMF221'. Ferrule 111a-1', collimate lens 112-1', birefringence crystal 120a-1', and lens-holder 130' have offered the same composition as ferrule 111a-1, the collimate lens 112-1, birefringence crystal 120a-1, and the lens holder 130 of

excitation photosynthesis section 100a-1 which are shown in drawing 1 , respectively, and the explanation is omitted.
[0120] By above-mentioned composition, the light by which outgoing radiation was carried out from optical outgoing radiation equipment 104 Incidence is carried out to the end side (left lateral in drawing 10) of birefringence crystal 120a-1', and it sets in this birefringence crystal 120a-1'. While the light which has the plane of polarization which intersects perpendicularly with the crystallographic axis v of birefringence crystal 120a-1' passes through the inside of birefringence crystal 120a-1' by linearity high as Tsunemitsu The light which has plane of polarization parallel to the crystallographic axis v of birefringence crystal 120a-1' passes being greatly refracted as an unusual light, and outgoing radiation of such light is carried out from the separate position in the other end side of birefringence crystal 120a-1'.
[0121] Each light which carried out outgoing radiation from birefringence crystal 120a-1' advances into an equidistant position from the medial axis of collimate lens 112-1', respectively, and passes collimate lens 112-1'. It has a predetermined outgoing radiation angle from the other end side of collimate lens 112-1', and outgoing radiation of it is carried out and incidence is carried out to PMF211' and 221' by each light, respectively while it is changed into a collimation beam by passing through the inside of this collimate lens 112-1'.
[0122] In addition, in the operation form shown in drawing 10 , although the crystallographic axis v of birefringence crystal 120a-1' inclines acutely (for example, this operation form 45 degrees) to the travelling direction of the light which carries out incidence, incidence of the light which has the plane of polarization which intersects perpendicularly with this crystallographic axis v is carried out to PMF221', and incidence of the light which, on the other hand, has plane of polarization parallel to a crystallographic axis v is carried out to PMF211'.
[0123] Thus, according to the polarization decollator as the 2nd operation form of this invention By lens assembly 110a-1' and birefringence crystal 120a-1' From the ability of polarization separation for it to be made to be able to dissociate easily for every polarization component of the light by which incidence was carried out, and to be realized in one port and also it can attain the miniaturization of the mounting size of equipment -- use -- small and the polarization diversity receiver of a low cost can be manufactured by being able to attain low-cost-ization by curtailment of a member, for example, using for the receive section of polarization diversity etc.
[0124] Moreover, in the range which does not deviate from the meaning of not only the receive section of polarization diversity but this invention, the polarization decollator as the 2nd operation form of this invention can deform variously, and can be carried out.
(F) In addition, although the excitation optical output equipment shown in drawing 3 offers excitation photosynthesis section 100a-1,100a-2 shown in drawing 1 and consists of above-mentioned operation forms, this invention is not limited to this, may offer and constitute which the excitation photosynthesis section shown in drawing 7 - drawing 9 , in the range which does not deviate from the meaning of this invention, can deform variously and can carry it out.
[0125] Moreover, although polarization decollator 100a-1' and 100a-2' on which the excitation light decollator shown in drawing 4 also offered the almost same composition as excitation photosynthesis section 100a-1,100a-2 shown in drawing 1 are offered and it consists of above-mentioned operation forms this invention is not limited to this, may offer and constitute the same polarization decollator as which the excitation photosynthesis section shown in drawing 7 - drawing 9 , in the range which does not deviate from the meaning of this invention, can deform variously and can carry it out.
[0126] Furthermore, although light-receiving 830,150,160,310-PDs 340,370 is used with the above-mentioned operation form in the excitation optical output equipment shown in drawing 3 , and the excitation light decollator shown in the polarization synthesizer unit and drawing 4 which are shown in drawing 8 and drawing 9 , this invention is not limited to this, may use an invar RANSHIE photodiode, in the range which does not deviate from the meaning of this invention, can deform variously and can carry it out.
[0127] And this invention is not limited to each operation form mentioned above, in the range which does not deviate from the meaning of this invention, can deform variously and can be carried out.
[0128]
[Effect of the Invention] As explained in full detail above, while offering the lens assembly which comes to offer a fixing member and a lens according to the polarization synthesizer unit of this invention By offering and constituting the birefringence member which carries out polarization composition by using two or more above-mentioned kinds of polarization component light as the same optical axis and also it can perform polarization composition in one port, it can realize polarization composition in one port and it can attain the miniaturization of a mounting size -- manufacture -- easy -- further -- use -- there is an advantage which can attain low-cost-ization by curtailment of a member (a claim 1, claim 5)
[0129] Moreover, the edge of the two above-mentioned optical fibers can use a monotonous birefringence crystal for the fixing member of each other as a birefringence crystal proximity or by making it incline and constituting that fixing arrangement should be carried out so that it may touch, and there is an advantage which manufacture of a birefringence crystal is easy and can aim at reduction in a manufacturing cost (claim 2). Furthermore, by constituting by joining two

ferrule members which fix each of two optical fibers for a fixing member, manufacture of the fixing section becomes easy and there is an advantage which can aim at reduction in a manufacturing cost (claim 3).
[0130] Furthermore, also by constituting that fixing arrangement of the two above-mentioned optical fibers which can carry out outgoing radiation of the two different light in which a fixing member has the plane of polarization which intersected perpendicularly mutually should be carried out in parallel, manufacture of the fixing section becomes easy and there is an advantage which can aim at reduction in a manufacturing cost (claim 4). Moreover, among two or more plane of incidence in which two or more above-mentioned kinds of polarization component light in a taper-like birefringence crystal carries out incidence By offering and constituting the monitor section in the reflected light on the street by the coupler film, while carrying out the vacuum evaporationo of the coupler film to plane of incidence with a large incident angle Since the lightwave signal of excessive optical level is not sent out to an optical fiber except that the excitation optical output which could control polarization component light and was stabilized can be obtained, Relay amplification is cumulatively carried out through a transmission line, other repeaters, etc., and there is no possibility of affecting the quality of optical parts which receives a lightwave signal in a receive section so that excessive output light may not become still larger in the stage which receives a lightwave signal in the terminal office (a claim 6, claim 7).
[0131] Furthermore, by offering and constituting two or more photodiodes which carry out the monitor of the monitor section individually about two or more kinds of each polarization component light, it can control separately for every polarization component light, and there is an advantage which is quality and can obtain a reliable polarization synthesizer unit from the ability of excitation **** control of a high level to be performed more (claim 8). moreover -- and also according to the polarization decollator of this invention it can perform polarization separation in one port and can attain the miniaturization of a mounting size by offering and constituting the lens assembly which comes to offer a birefringence member, and a lens and a fixing member -- manufacture -- easy -- further -- use -- there is an advantage which can attain low-cost-ization by curtailment of a member (claim 9)
[0132] Furthermore, by offering a fixing member, a lens assembly, and a birefringence member, and constituting the polarization composition section, the excitation optical output equipment of this invention can reduce the number of ports, and is equipment of small and simple composition. use since polarization composition of the excitation light of each wavelength can be carried out, and the whole equipment can be miniaturized and it can constitute simply -- there is an advantage which can attain low-cost-ization by curtailment of a member (claim 10)
[0133] Moreover, by constituting so that the light compounded in the polarization composition section may be used as the object for front excitation to the remote light amplifier connected through the output optical fiber, or an excitation light for back excitation use since the whole equipment can be miniaturized also in the optical transmission device which transmits signal light and it can constitute simply between long distances -- there is an advantage which can attain low-cost-ization by curtailment of a member (a claim 11, claim 14)
[0134] furthermore, use since the whole equipment can be miniaturized from the ability of wavelength multiplex or wavelength separation to also be performed in the same equipment by offering and constituting the wavelength demultiplexing section which performs wavelength multiplex or wavelength separation processing to excitation optical output equipment and it can constitute simply -- there is an advantage which can attain low-cost-ization by curtailment of a member (claim 12)
[0135] The 1st polarization composition section Moreover, the 1st fixing member and the 1st lens assembly, While the 1st birefringence member is offered and constituted, the 2nd polarization composition section by offering and constituting the 2nd fixing member, the 2nd lens assembly, and the 2nd birefringence member use since the whole equipment can be miniaturized and it can constitute simply -- there is an advantage which can attain low-cost-ization by curtailment of a member (a claim 13, claim 15)

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing typically the composition of the polarization synthesizer unit as the 1st operation gestalt of this invention.
[Drawing 2] It is drawing showing typically the composition of the optical transmission system which applied the excitation optical output equipment as the 1st operation gestalt of this invention.
[Drawing 3] It is the cross section showing typically the composition of the excitation optical output equipment as the 1st operation gestalt of this invention.
[Drawing 4] It is the cross section showing typically the composition of the excitation light decollator (optical transmission device) using the polarization decollator as the 1st operation gestalt of this invention.
[Drawing 5] (a) and (b) are drawings for explaining the transparency property of a synthetic membrane and a WDM film, respectively.
[Drawing 6] (a) - (c) -- respectively -- fixing -- it is drawing for explaining the composition of a member
[Drawing 7] It is the cross section showing typically the composition of the 1st modification of the polarization synthesizer unit as the 1st operation gestalt of this invention.
[Drawing 8] It is the cross section showing typically the composition of the 2nd modification of the polarization synthesizer unit as the 1st operation gestalt of this invention.
[Drawing 9] It is the cross section showing typically the composition of the 3rd modification of the polarization synthesizer unit as the 1st operation gestalt of this invention.
[Drawing 10] It is the cross section showing typically the composition of the polarization decollator as the 2nd operation gestalt of this invention.
[Drawing 11] It is the plan showing the composition of conventional excitation optical output equipment typically.
[Drawing 12] It is drawing showing the composition of the conventional polarization synthesizer unit typically.
[Description of Notations]
100a-1,100a-2,100b-100d Excitation photosynthesis section (polarization composition section)
100a-1' Polarization decollator
110a-1,110a-1', 110a-2,110b Lens assembly
111a-1,111a-1', 111a-2 Ferrule (fixing member)
111a-11,111a-12 Half-segmented ferrule (ferrule member)
112,112-1,112-1', 112-2 Collimate lens (lens)
120a-1,120a-1', 120a-2,120b-120d Birefringence crystal
121 Coupler Film
150,160 Light-receiving PD (monitor section)
200,210-240 LD for excitation
211,221,211', 221', 231,241 PMF (an optical fiber, plane-of-polarization maintenance optical fiber)
1001 1002 Optical transmission device
2000 Excitation Optical Output Equipment
3000 Excitation Light Decollator
45 Synthetic Membrane
46 WDM Film (Wavelength Demultiplexing Section)
810 Signal Light LD
740,750 Remote amplifier (remote light amplifier)

[Translation done.]

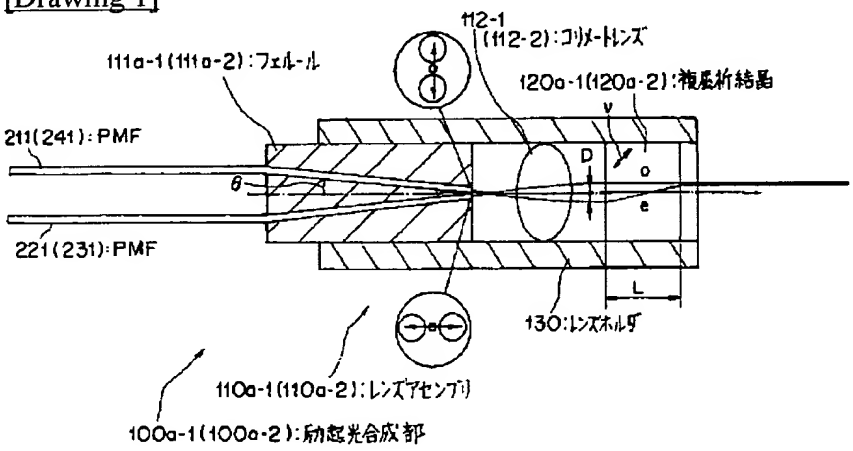
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

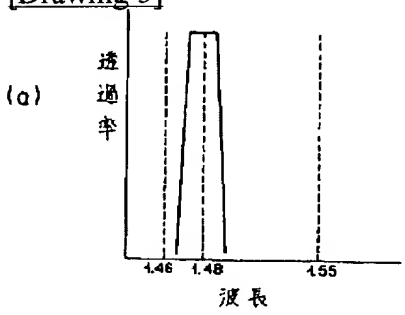
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

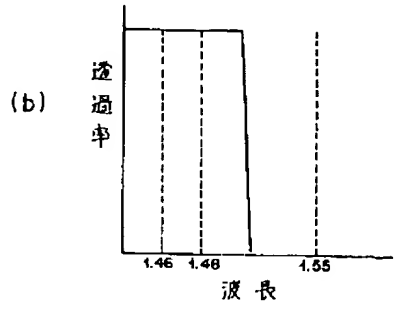
DRAWINGS

[Drawing 1]

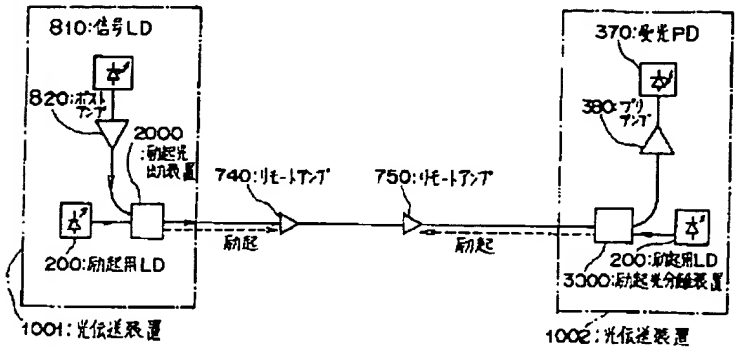


[Drawing 5]

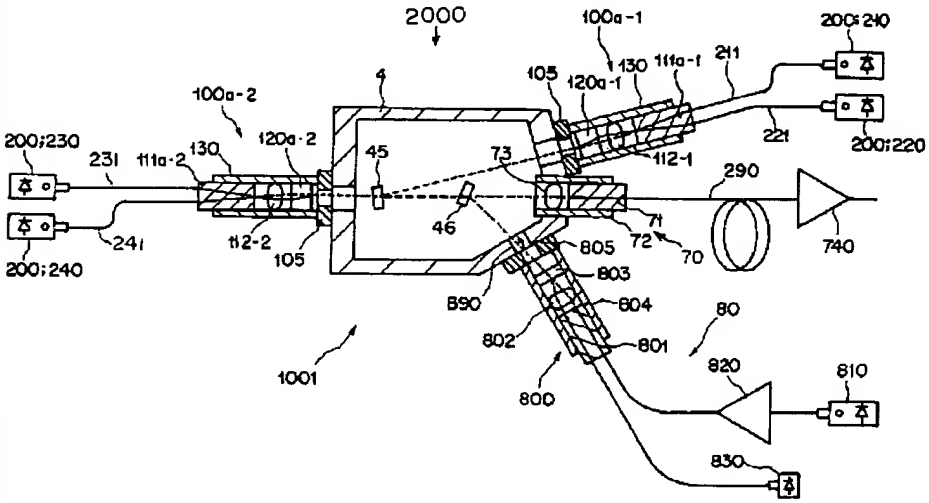




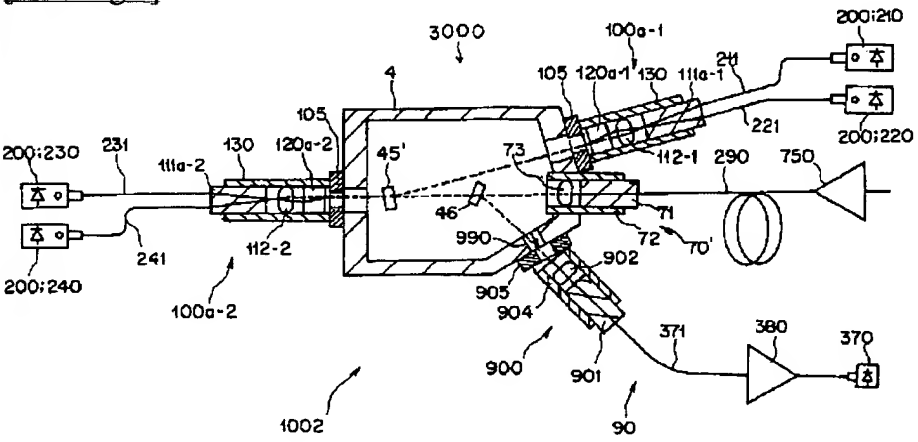
[Drawing 2]



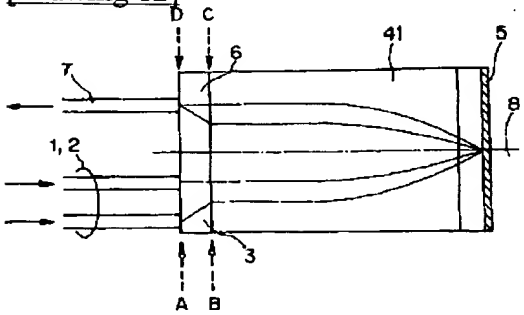
[Drawing 3]



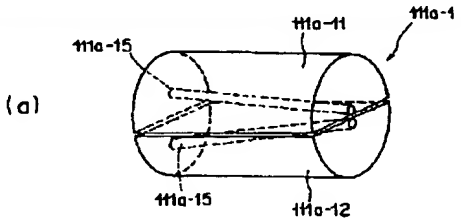
[Drawing 4]

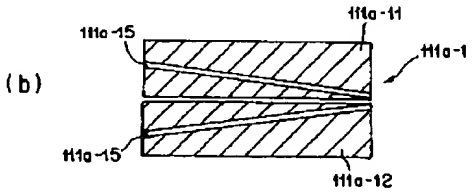


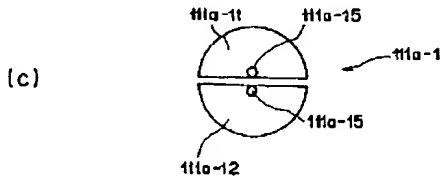
[Drawing 12]



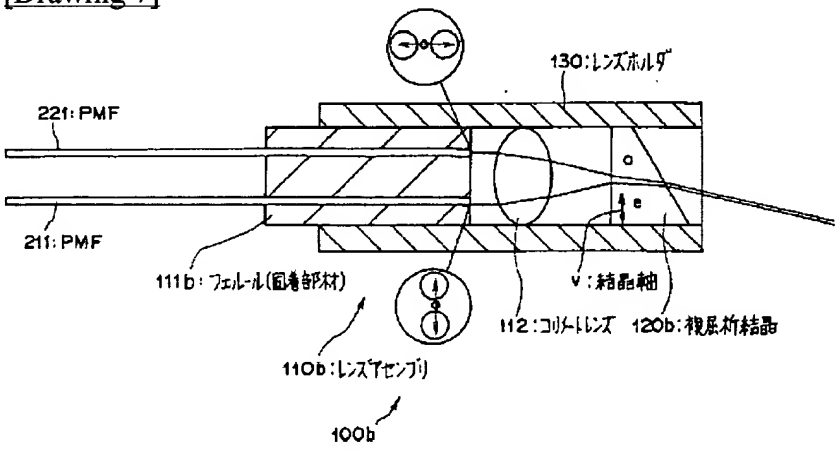
[Drawing 6]



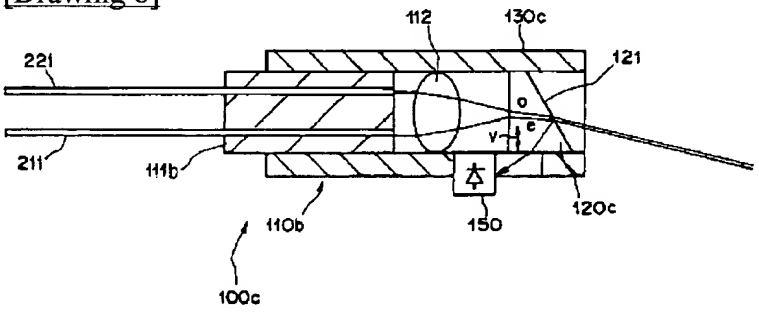




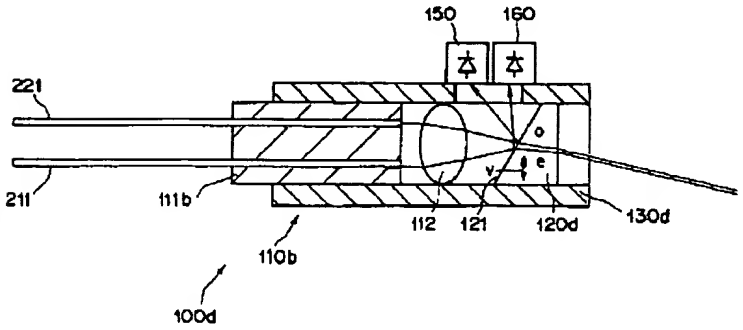
[Drawing 7]



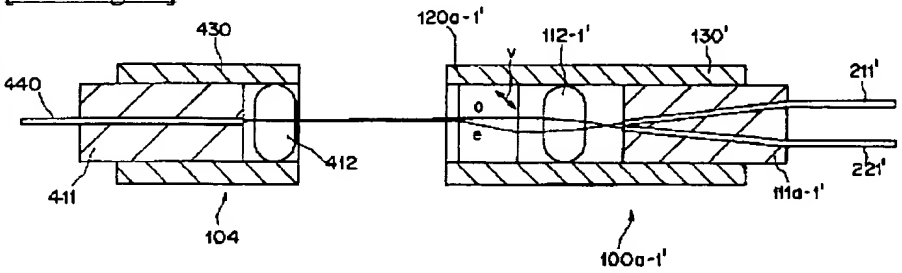
[Drawing 8]



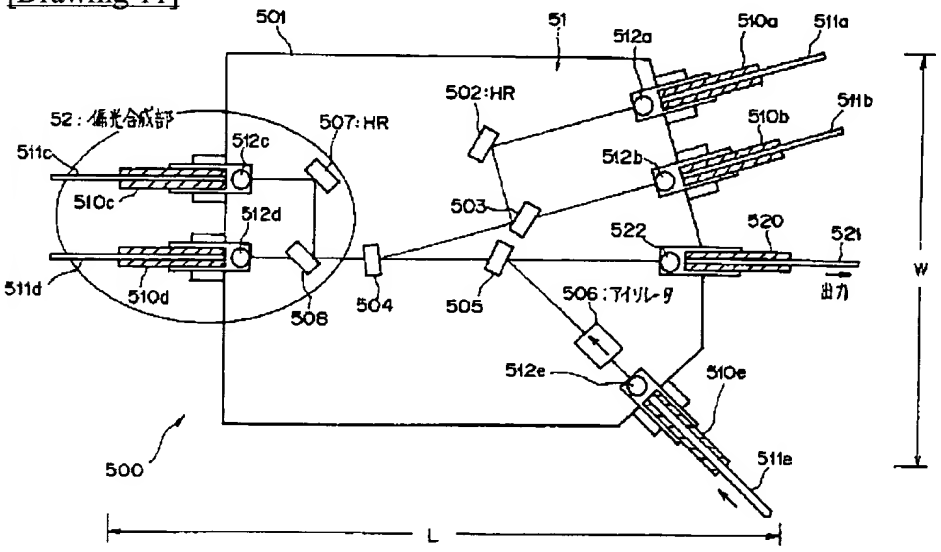
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]